PSYCHE.

ON A RATIONAL NOMENCLATURE OF THE VEINS OF INSECTS, ESPECIALLY THOSE OF LEPIDOPTERA.

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Hitherto there has been an unfortunate lack of uniformity in the nomenclature of the veins of the wings, different names having been applied to the veins of different orders.

In his paper on the phylogeny and ontogeny of the veins of the wings of Lepidoptera Spuler has, however, given us a simple scheme and a numbering of the veins which will, we think, apply in general to the wings of insects of all orders.

Redtenbacher had previously pointed out that "the geologically older Orthoptera and Neuroptera have a much richer and more complicated venation than the Coleoptera, Lepidoptera, Hymenoptera and Diptera; thus among the Rhynchota, the oldest forms, the Cicadidae and Fulgoridae have a much greater number of veins than the Hemiptera. There is no doubt but that the oldest insects were provided with an excess of veins, that on the other hand in the course of development this superfluity has disappeared by a process of reduction, and in this way a simpler system of venation has resulted. It is also to be observed that the size of the wings has had a considerable influence on the number of the veins, since small forms almost without exception have fewer veins than insects with large wings." Redtenbacher also believes "that the normal type of a differentiated wing may be found in those insects whose fore and hind wings are most similar in size and shape," and states that the venation is not useful as an ordinal character, but is of more service in separating suborders and families.

We agree with Spuler in rejecting Redtenbacher's system, which is partly based on Adolph's untenable theory of convex and concave veins, but more especially for the reason that Redtenbacher assumes that the primitive form of venation is that of the Ephemeridae. He remarks: "There is scarcely another group of insects whose wings show the primitive type, the fan-shaped form, as the May-flies." It may be objected to this that the Ephemeridae, though in most respects generalized and primitive insects, yet are, as regards the wings, highly modified or specialized. That this is the case is also suggested by the reduction or atrophy of the mouth-parts.

On the other hand the retention of sexual organs paired throughout, the ducts remaining separate, with open, paired outlets, shows that the May-flies are, in this respect, more primitive than any other winged insects. But as regards the thorax and the wings, we observe that in them a high degree of modification has taken place. Thus the two pairs of wings are very unlike in size and shape, and this feature is a secondary one. Hence the large number of main longitudinal veins in the wings of Ephemera is a case of irrelative repetition of parts mostly situated in the fan-like field, due to a process of specialization, a process which is manifested in quite another way in the wings of the Dermaptera, also a primitive type. Redtenbacher regards the eleven longitudinal veins (I–XI) of Ephemerids as the normal number, and considers that the Trichoptera, Lepidoptera, etc., have lost certain of the veins by a process of reduction. This view has been adopted by Comstock in his suggestive paper, "Evolution and Taxonomy," but it seems to us to be untenable, the anal field ("faltentheil" of Spuler) not being of primary importance. On the other hand Redtenbacher's use of Roman numerals for the main veins, and of a combination of Roman and Arabic numerals for their branches, is very convenient.

Spuler divides the wings of each pair into an outspread portion (*Spreitentheil*), and a folded part (*Faltentheil*). The veins of the former area he numbers in the same manner as Redtenbacher, beginning on the costal edge of the wing, while those of the folded area (the submedian and internal or first and second anal veins of other authors) he does not name, but simply numbers with Greek letters α β. He considers that Hagen was right in believing the Phryganidae, Tipulariae and some Microlepidoptera to be forms with a schematic, *i. e.*, primitive venation (Stettin. Ent. Zeit., p. 316, 1870).

Spuler shares the opinion of Fritz Müller (Termitidae), Brauer and Redtenbacher (Libellulidae), and Haase (Papilionidae), that the costa is only a hypodermal structure, a thickening of the edge, which does not have a trachea as its origin (anlage), and which therefore has nothing to do with the veins.

Spuler also shows that the venation of the Orthoptera, especially their most generalized form Blatta, is fundamentally nearly identical with that of the Lepidoptera, veins I–V being readily homologized with those of the latter group; so also with the most generalized Hemiptera (Fulgora, Fig. 1). We may also draw attention to

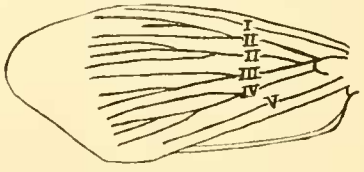


Fig. 1.

the remarkable resemblance in the venation of the generalized Psocid genus Amphientomum, which at first

sight, from the shape and size of the wings, reminds one of a Micropteryx or Eriocephala, while it also has a few scales like those of these moths.

But that the system of venation of Spuler is morphologically the correct one is fully and satisfactorily proved by the ontogenetic development of the veins. Fritz Müller (Kosmos i, p. 390) was the first to examine the incipient venation of two semi-pupal moths (*Castnia ardalus*). He observed that in the immature pupa the cross veins were wanting, and that different longitudinal veins, which afterwards more or less completely disappeared, were present, and hence he regarded the pupal venation as the primitive one. This view Spuler has adopted and extended, and it plainly enough, supported by the researches of Brauer and Redtenbacher on the venation of the nymph of Odonata, solves the problem of the venation of insects in general, and especially for Neuroptera, Trichoptera, Mecoptera (Panorpidae), Lepidoptera and Diptera.

Spuler's method was to strip off the loose skin of a caterpillar just beginning to pupate, and examine the incipient venation of the wings of the young pupa on the living insect. He placed the living pupa in water and then, since the process of thickening and resulting concealment of the veins of the wing is retarded, the tracheal branches become slightly enlarged, filled with air, and thus are more easily seen. Hence small pupae from which the larval skin has just been cast, and are transparent, are the fittest objects for examination.

The primitive and generalized condition of the semipupal wing is shown in Spuler's figure of *Cerura vinula* (Fig. 2), to which we have added the

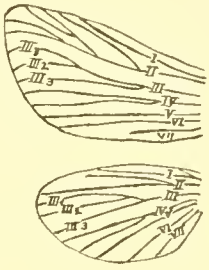


Fig. 2

numbering of all the veins. He shows that the fundamental pupal venation of Lepidoptera will also apply to Orthoptera (Blatta), Hemiptera, Trichoptera, etc. He proves that the cross veins are of quite secondary and subordinate importance. The results of Spuler's investigations, extended through different groups from Tineina to Rhopalocera, and illustrated by many figures, are both interesting and convincing. The comparison of the venation of the fore wing of the adult

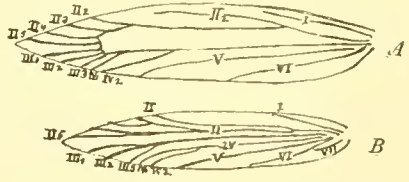


Fig. 3

of *Gracilaria syringella* (Fig. 3 A) compared with that of its semipupa (Fig. 3 B), shows that the generalized

venation of the latter is similar to that of Micropteryx, veins IV_1 IV_2 not being connected by a cross vein with III and its branches, and veins II and III, with their branches, being separate. The veins and their numbering

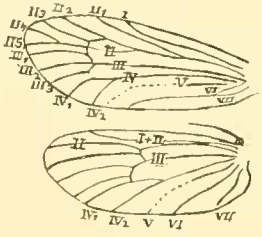


Fig. 4.

are indicated by Spuler's figure of *Talaeporia pseudobombycella* (Fig. 4) and one we have drawn of *Hepialus mustelinus* (Fig. 5).

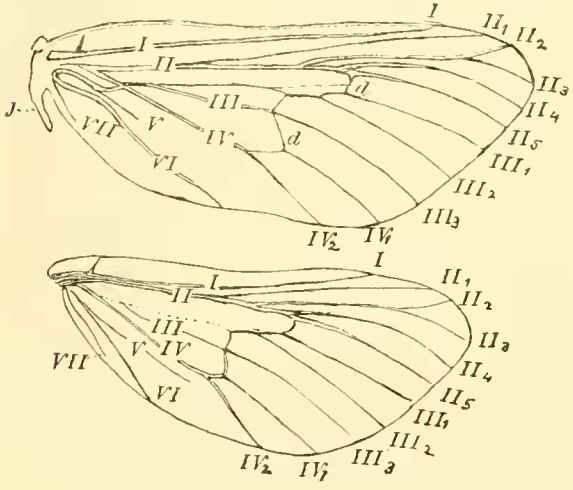


Fig. 5.

The structure of a complete vein is described by Spuler. In a cross-section of a Noctuid (*Triphaena pronuba* Fig. 6) the chitinous walls are seen to consist of two layers, an outer (*U*) and inner (*c*), which takes a stain and lies

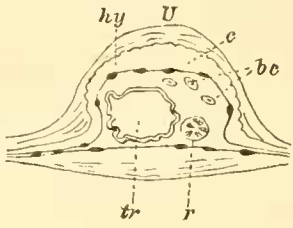


Fig. 6.

next to the hypodermis (*hy*). In the cavity of the vein is the trachea (*tr*), which shows more or less distinctly the so-called spiral thread; within the cavity are also Semper's rib (*r*) and blood corpuscles (*bc*), which proves that the blood circulates in the veins of the completely formed wing, though this does not appiy to all Lepidoptera with hard mature wings. I have been able to observe the same structure in sections of the wing of Zygaena.

A cross-section of a vein of the immature pupa of *Pieris brassicae* shows that the large trachea is first formed, and that it extends along the track between the protoplasmic threads connecting the two hypodermal layers.

The main tracheae throw off on both sides a number of secondary branches showing at their end a cell with an intracellular tracheal structure; these accessory tracheae afterwards branch out.

The accessory or cross-tracheae often disappear, though in some moths they

remain permanently. Fig. 7 tr_2 represents these secondary veins in the

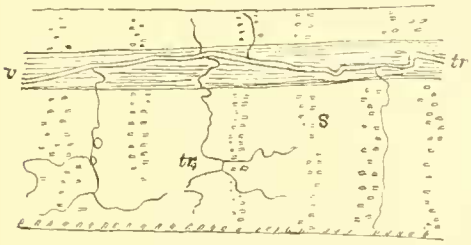
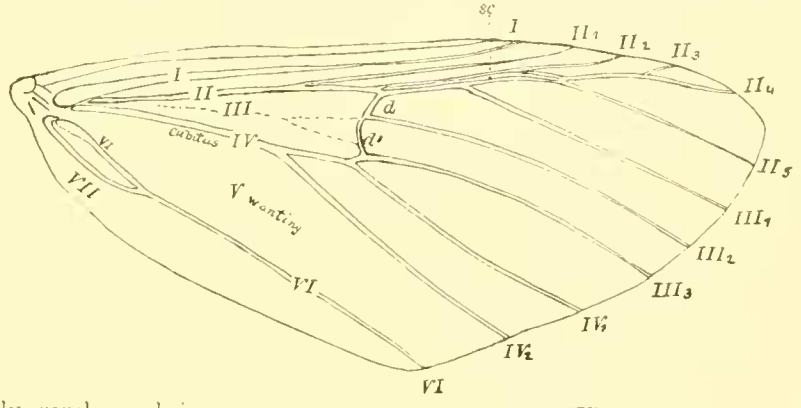


Fig. 7

edge of the fore wing of *Laverna vanella*, arising from a main trachea (*tr*) passing through vein I, two of the twigs extending to the centre, showing that the latter has no homology with a vein. Only rarely and in strongly developed thick folds are the cross-tracheae provided with a chitinous thickening, as for example in *Cossus ligniperda*. Since from such accessory tracheae the cross-veins in lepidopterous wings are developed, we can recognize in them the homologies of the net-veins in reticulated venations. There is no sharply defined difference between reticulated and a non-reticulated venation; no genetic difference exists between the two kinds of venation, since there occur true Blattidae with and without a reticulated venation (Spuler).

It may be remarked that Spuler agrees with Brauer and Redtenbacher, as well as Haase, that Adolph's system of convex and concave veins is entirely erroneous.

We adopt, then, Spuler's system of venation, and earnestly trust that it



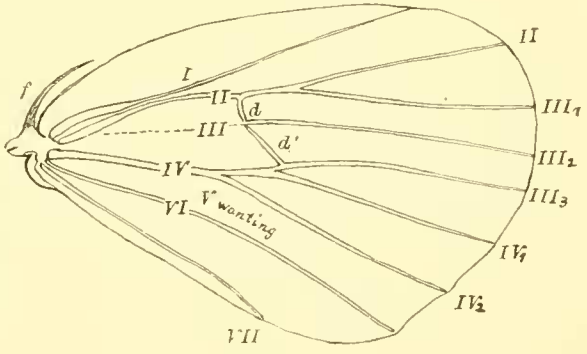


Fig. 8.

may be generally accepted, as simple, intelligible, and applicable to all orders of insects, based as it is on ontogenetic, as well as anatomical, grounds.

The following system applies to the Lepidoptera as well as all other orders. Fig. 8 represents the venation of a Notodontian (*Heterocampa obliqua*). We merely deviate, from motives of convenience, from Spuler's numeration of the two anal veins, by numbering them VI and VII, instead of designating them by the Greek letters α β.

The following table will show the numbers and names of the five veins of the outspread portion of the wing and two (rarely three) of the fan-like or inner portion. Instead of denoting the veins by the noun and adjective as, for example the median vein, we may call it in descriptions or diagnoses, *media*.

I. Costa.

II. Subcosta (radius).

III. Media.

IV. Cubitus (median vein of some authors).

V. First anal (submedian).

VI. Second anal (internal).

VII. Third anal.

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THE GENUS OXYPTILA.

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Oxyptila is a genus of Thomisoid spiders, described by Simon in 1864. I consider the characters of this genus in our fauna are that the quadrangle of the M. E. is higher than broad, that the P. M. E. are closer to each other than to the S. E., and that the body bears clavate hairs. Thus I would not place in the genus *O. cinerea* Em. (New Eng. Thomisidae), as it bears no clavate hairs and as it has much the appearance of a true *Xysticus*. In 1877 Thorell described one species of this genus, *O. conspurcata*, from Colorado. In 1880 Keyserling described two species, *O. georgiana* and *O. nevadensis*. In 1882 Kyserling described a third species, *O. monroensis* from Ft. Monroe, Va. Dr. Marx in 1890 recorded this species from D. C. In 1892 I recorded both *O. georgiana* and *O. conspurcata* from Ithaca, N. Y. I have since decided that *O. georgiana* is the same as *O. conspurcata*; at least I can see no other than color differences between forms which agree with the descriptions; and the form which I recorded from New York as *O. georgiana* is not that species, but is new. I have since received two other new species and obtained *O. monroensis* from Long Island. The six species may be tabulated as follows:—

1	No spines above on metatarsus I, quite black species . .	*floridana.*
	At least one spine above on metatarsus I	2.
2	Two spines above on metatarsus I	*nevadensis.*
	But one spine above on metatarsus I	3.